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IMPROVEMENTS TO THE WATER SUPPLY OF ST. JOHN'S, NEWFOUNDLAND[1]

By F. F. Longley

The City of St. John's, Newfoundland, has for some years past been troubled with deficient quantity and pressure in its water supply, and asked advice about a year and a half ago as to the situation and suitable remedies.

St. John's has taken its water supply for many years past from Windsor Lake, some four or five miles west of the city. This lake lies at an elevation of about 500 feet above sea level. Its capacity is large and it has always been, and is still adequate for the needs of the city. The watershed is almost without habitation, and the quality of the water, without any treatment, is therefore excellent. From the easterly end of the lake a conduit extends about two miles to a basin. From this basin two pipe lines, mainly 16 inches in diameter, extend to the city by two different routes.

The most obvious defect in the entire system was the inadequacy of the distributing mains in the city. The accompanying diagram shows in full lines the larger mains of the distribution system as it then was, and in broken lines the mains that were recommended to improve the conditions of distribution. The consumption of water in the city averages about five million imperial gallons a day. It will be noted at once that for a city of this size and with this consumption of water, the system is extremely weak in large mains. This naturally resulted in a great loss in pressure, especially when the consumption rose towards its maximum.

Winter conditions have always imposed a severe drain on the water supply, as the construction of the houses and the design of the plumbing and the methods of heating in common use do not tend to prevent the freezing of the pipes within the houses, and the water is quite commonly permitted to run to prevent freezing. The cold weather draft of water, therefore, runs up very high and at these times the pressure in the city has at certain times and certain places almost disappeared. Besides the reduction of waste, the thing that was obviously needed was a few main arteries which would carry the quantity of water demanded by the city to the most remote parts with a minimum loss of head. The diagram shows the location and extent of these additions. The work of laying these new mains went forward during the past summer and at the end of the working season most of the mains lying in the city had been laid and were ready to put in service.

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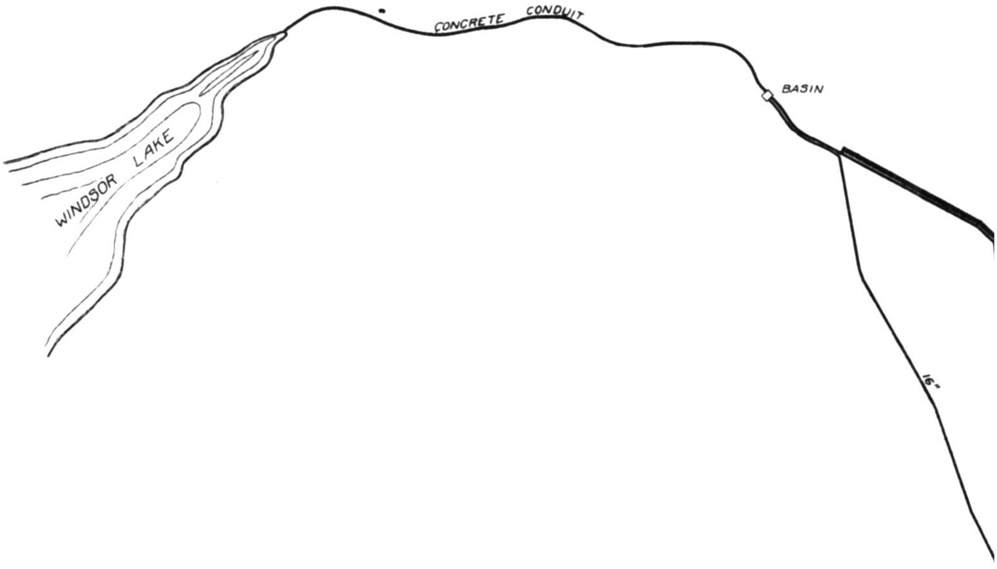
[1] Presented at New York Section of the American Water Works Association, February 16, 1916.

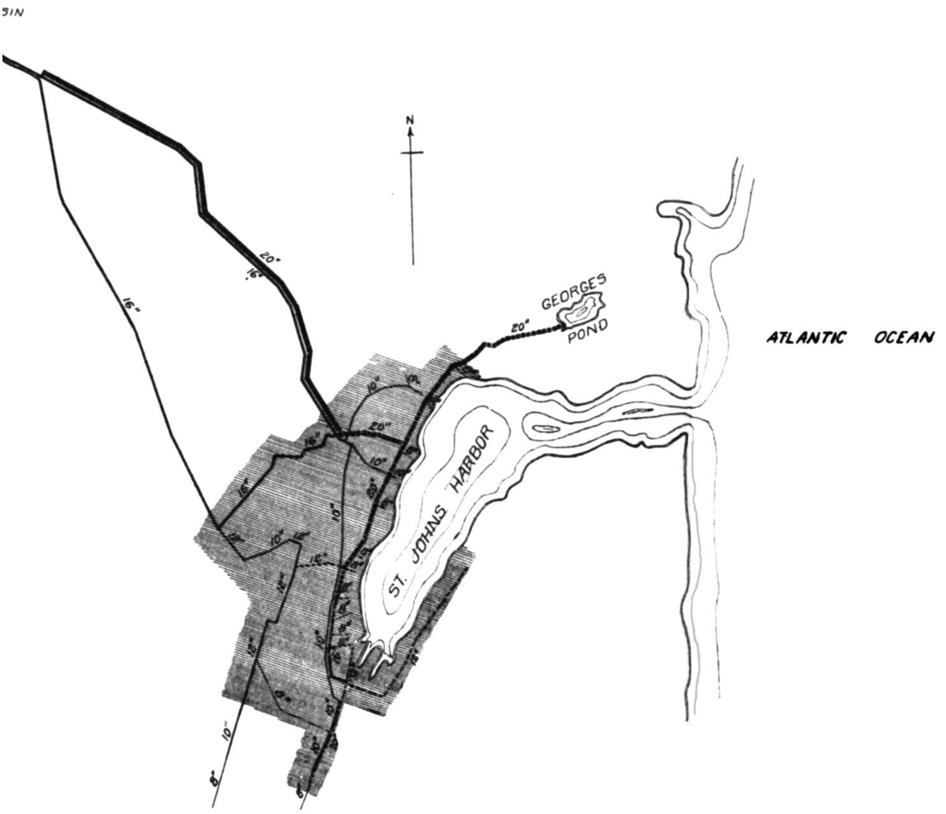
A series of tests were at that time made upon the improved system. The first was a leakage test. Some 8000 feet of 20 inch and 16 inch mains were tested under approximately the normal working pressure, and found to give a leakage not exceeding about two gallons per minute, indicating that the work had been well done. Then fire stream tests were made, to show the improvement secured by the addition of these mains in the pressures over the lower part of the city. A quantity of hose and play pipes were borrowed from the fire department and streams taken from a number of hydrants along the busy part of the principal business streets, the streams discharging into the harbor. The maximum number of fire streams thus taken was eleven. Pressures were observed at a convenient hydrant from which no fire stream was being drawn.

As the system stood before the new mains were connected with the old ones, the pressure along Water Street was drawn down by these eleven fire streams to about 36 pounds. It is proper to note that the regular consumption at this time was moderate, and therefore the prevailing pressures about as good as could ever be secured in recent years. One fire stream after another was then shut off and the resulting pressures noted as the draft diminished until finally all of them were shut off. The results of this procedure are shown graphically on the diagram. After the new mains had been connected to the old ones, this procedure was repeated. The pressure in this case, with eleven fire streams being drawn, was reduced only to 68 pounds, and the successive increases in pressure resulting from the diminishing number of fire streams as they were successively cut off is again shown on the diagram.

The presence of the new mains, therefore, increased the fire service in this part of the city approximately as follows: The pressure which yielded four fire streams in the old system now yields ten streams; the pressure which yielded three fire streams in the



Hazen, Whipple & Fuller
Consulting Civil Engineers
30 East 42nd St. New York
Feb 2, 1916



CITY OF ST JOHNS N.F.
IMPROVEMENTS TO WATER SUPPLY

DIAGRAM OF PRINCIPAL MAINS

SCALE 1000 0 1000 2000 3000 FEET

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1946
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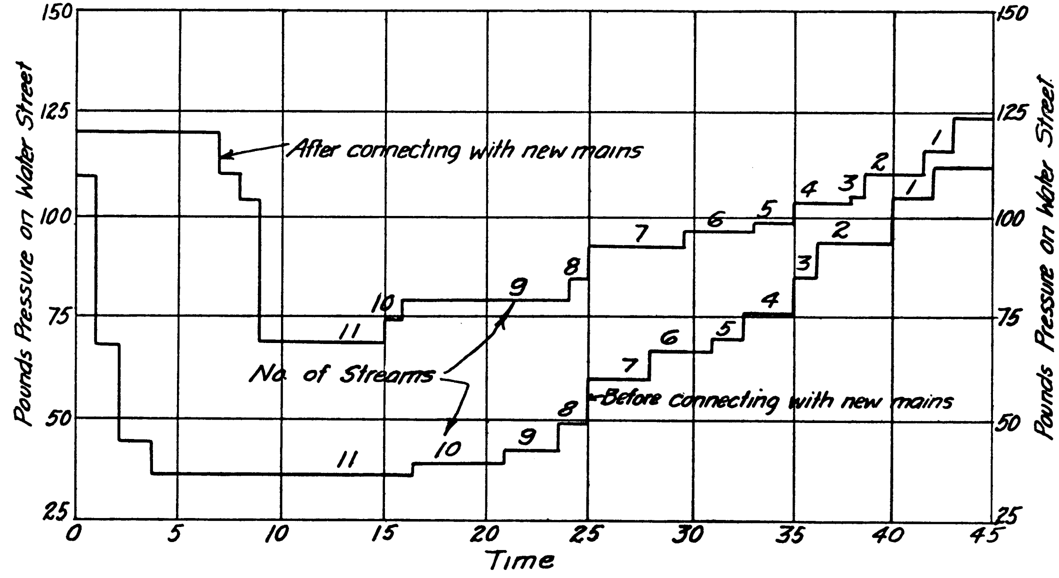

CITY OF ST. JOHN'S N.F.
FIRE STREAM TESTS
PRESSURES RESULTING WITH VARIOUS NUMBERS
OF FIRE STREAMS BEFORE AND AFTER CONNECTING
WITH NEW MAINS

Hazen Whipple & Fuller
Consulting Civil-Engineers
30 East 42nd St. New York
Feb. 3, 1916

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1915
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old system now yields eight; the pressure which yielded two fire streams in the old system now yields six.

Similar tests were not made in other parts of the city, but the arrangement of the new main arteries is such, that substantially similar results may confidently be expected in any part of the business district.

It should be noted, too, that all the benefits of the improvements are not yet secured. Those above mentioned are the result only of strengthening the distribution system within the city. Certain added benefits will follow the laying of the additional supply main from the source, and the connection with the new service reservoir.

The old water main in Water Street, the principal business street, is only 6 inches in diameter, totally inadequate in itself to serve the requirements of such a street. This street is paved and it was desirable, therefore, to lay the new main on a nearby parallel street that was not paved. In order to give to this small Water Street main the full benefit of the increased pressure in the new mains, a number of short connections were made 8 inches in diameter between the new 20 inch main feeder and the old 6 inch.

The new mains include also a 12 inch, running from the 20 inch up the hill in the western part of the city, to connect with the old 12 inch that leads from the westerly 16 inch supply line. Also a 12 inch around to the side of the harbor opposite the city, to afford fire protection to the docks and warehouses there. Also numerous extensions and replacements of smaller mains. The improved system will afford the city a much better distribution of pressures than it has had for many years past.

The intake of the system at Windsor Lake is quite inadequate. One of the most serious intake difficulties is with ice. In order to eliminate these difficulties and to provide means for maintaining an adequate supply under all conditions, plans have been made for a new intake of 36 inch steel pipe extending some 600 feet more or less into the lake.

In the past, the city has had no means of measuring the quantity of water used. Some measurements were made for the first time in the Fall of 1914, by means of a weir, but it is not convenient to get a continuous record by such a method. Plans have therefore been made for Venturi meter, gate house and connections which will afford complete means for the measurement and control of the flow.

St. John's has had no service reservoir in the past, depending upon the flow through the long supply lines to take care of the maximum as well as the ordinary draft. A natural lake known as George's Pond lies in an admirable location and at a most suitable elevation for a service reservoir. George's Pond has an area of about thirteen acres and a good depth. It lies at an elevation slightly higher than 300 feet above sea level and at a distance of only a few thousand feet from the eastern end of the city. Its drainage area, which is small, lies on the high ground immediately overlooking the sea to the east of the city, and this area is devoid of human habitation. The elevation of the pond is such as to give good pressure for domestic and fire service along the water front and for a considerable distance back into the city, and it gives hydraulic conditions that fit in well with the elevation of the main supply.

A 20 inch pipe is being laid to this pond from the mains in the city, thus affording an economical arrangement for a large reserve supply close to the city and securing also a considerable saving in the capacity required in the main supply lines to take care of the maximum demand.

The weir measurements that were made when this study was first taken up indicated that during that period of a week the average rate at which the water flowed to the city was 5.3 million imperial gallons per day, representing a per capita consumption of about 166 imperial gallons per day, based upon the population connected with the distribution system. The measurements indicated further that the maximum rate at which the water was drawn throughout the twenty-four hours during the week of test was 5.8 million and the minimum rate 4.7 million imperial gallons per day, the minimum being over 80 per cent of the maximum. This minimum flow did not represent a compensating flow to a reservoir or anything of that sort, but clearly indicated a large waste throughout the twenty-four hours. There are but few manufacturing or commercial establishments that consume any considerable quantities of water regularly at night and it is, therefore, probable that the waste is constantly going on day and night at a rate somewhat approaching the observed night rate of flow.

One of the points of most importance to the city, therefore, was the detection and elimination of this waste. The practice of wasting water through house fixtures in the wintertime to prevent freezing is common and is freely admitted on all sides, and unfortunately this practice is not confined to the houses of the poorer class. The effect of this winter waste is to lower the water pressures all over the city, sometimes to the point of disappearance in certain sections. Entirely apart from the winter waste, there is the continual waste mentioned above, which is roughly indicated by the night rate of flow. Much of this large amount of waste could be detected and eliminated if the problem were properly attacked. The most effective way of getting at this would be by the use of meters. This was recommended and it is to be hoped that the city will adopt the recommendation.

From the magnitude of the waste, it appeared that something might be done rather rapidly to indicate where the loss mainly occurred, by means of a subsurface study of the distribution system. Therefore various parts of the distribution system were isolated and a rough measurement of the night flow into such districts made, assuming this night flow to represent approximately the leakage therein. Suitable equipment for convenient and accurate measurement was not at hand and it was therefore necessary to improvise a method with the material available. This was done at first by simply connecting a hydrant within the isolated district to one outside, through a fire hose of known length and diameter, and measuring the drop in pressure between the two hydrants, making proper corrections for differences in elevation. The quantity flowing was then roughly estimated from the friction loss through this hose. This obviously was a preliminary step only, but it resulted in showing in what districts to look for large waste, and a rough approximation of the quantity of leakage therein.

Later, a meter was inserted in the hose line. Careful observation of the meter gave indications of changes in the rate of flow and this method was used to follow up the first method. The isolated district was then reduced in size by successively closing all available gates, while the meter was under continual observation, and this resulted in a much closer localization of the waste.

From these rather rough methods it was made clear that from 75 to 80 per cent of the total night flow in the districts examined was on the house services and only 20 to 25 per cent on the mains. This, of course, was followed up as vigorously as possible by a house to house inspection and produced results which have encouraged the city to plan further and more thorough work along similar lines.

Owing to the fact that the available force has been busily engaged during the past year on construction work, the matter of waste

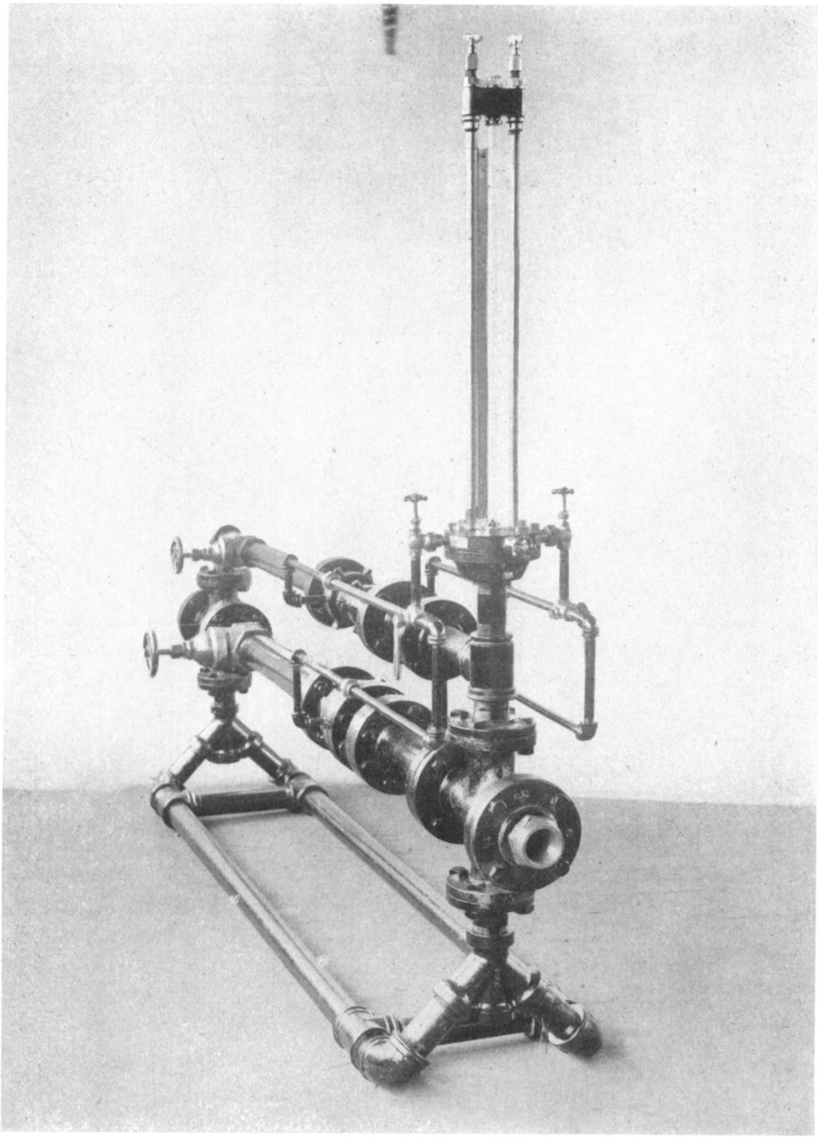

FIG. 3. WASTE DETECTING APPARATUS

reduction has not been followed up as actively as might have been wished, but it is to be followed up when conditions permit. An apparatus for use in connection with this work has been secured and a picture of it is shown herewith. It consists, as will readily be seen, of two small Venturi meter tubes, one 3 inch x 1½ inch, the other 2 inch x ⅝ inch, erected on the same stand and connected by suitable pressure pipes and valves to a manometer with two scales, one for each of the meter tubes. By means of this apparatus inserted in the hose line connecting two hydrants, one within and one outside of the isolated district, very small changes in rate of flow into the district may be observed, yielding information which will permit the elimination of even small amounts of waste on the various services. This equipment was tried out in St. John's two or three months ago and found to work with excellent satisfaction.